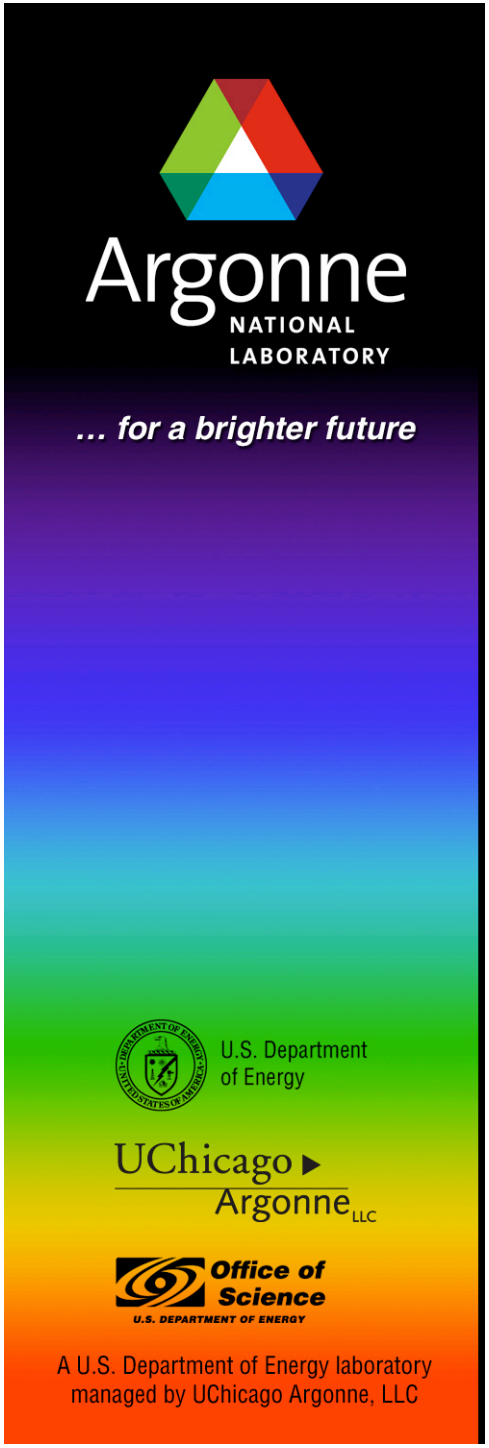
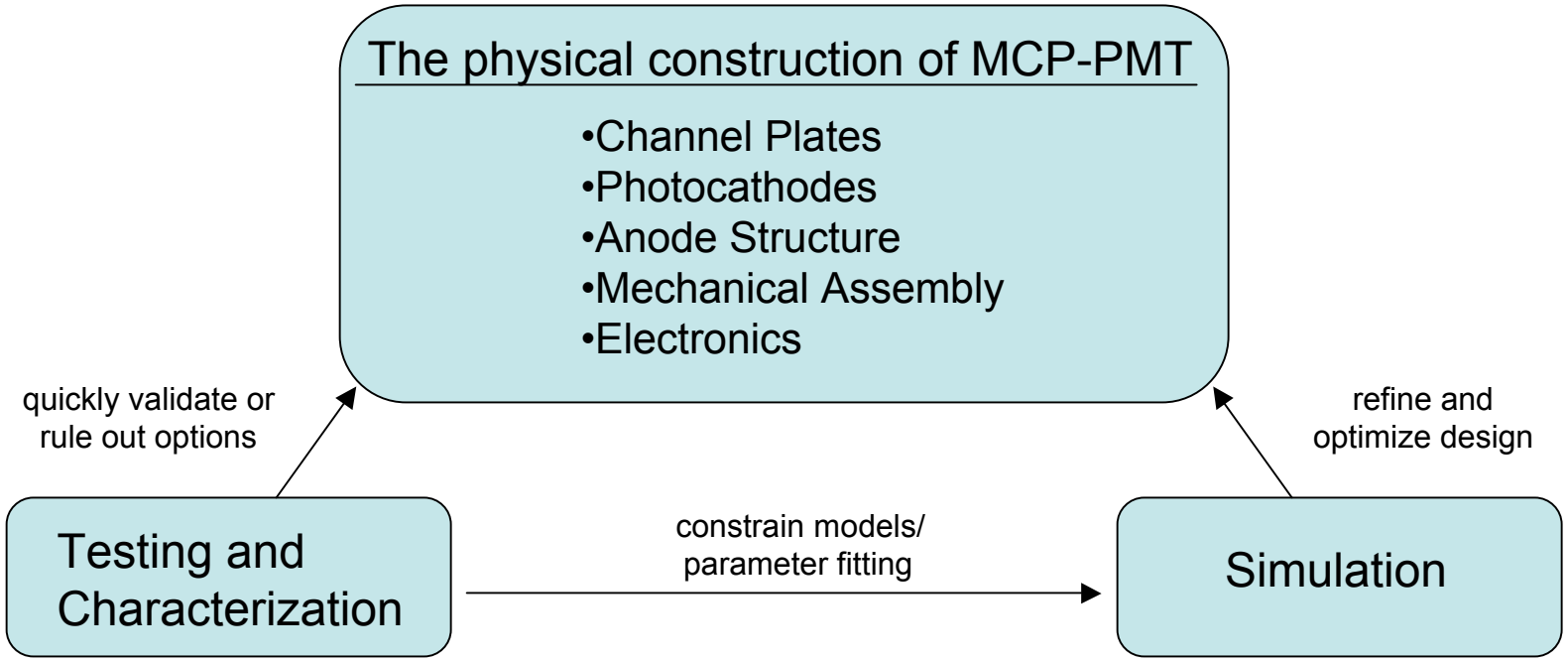


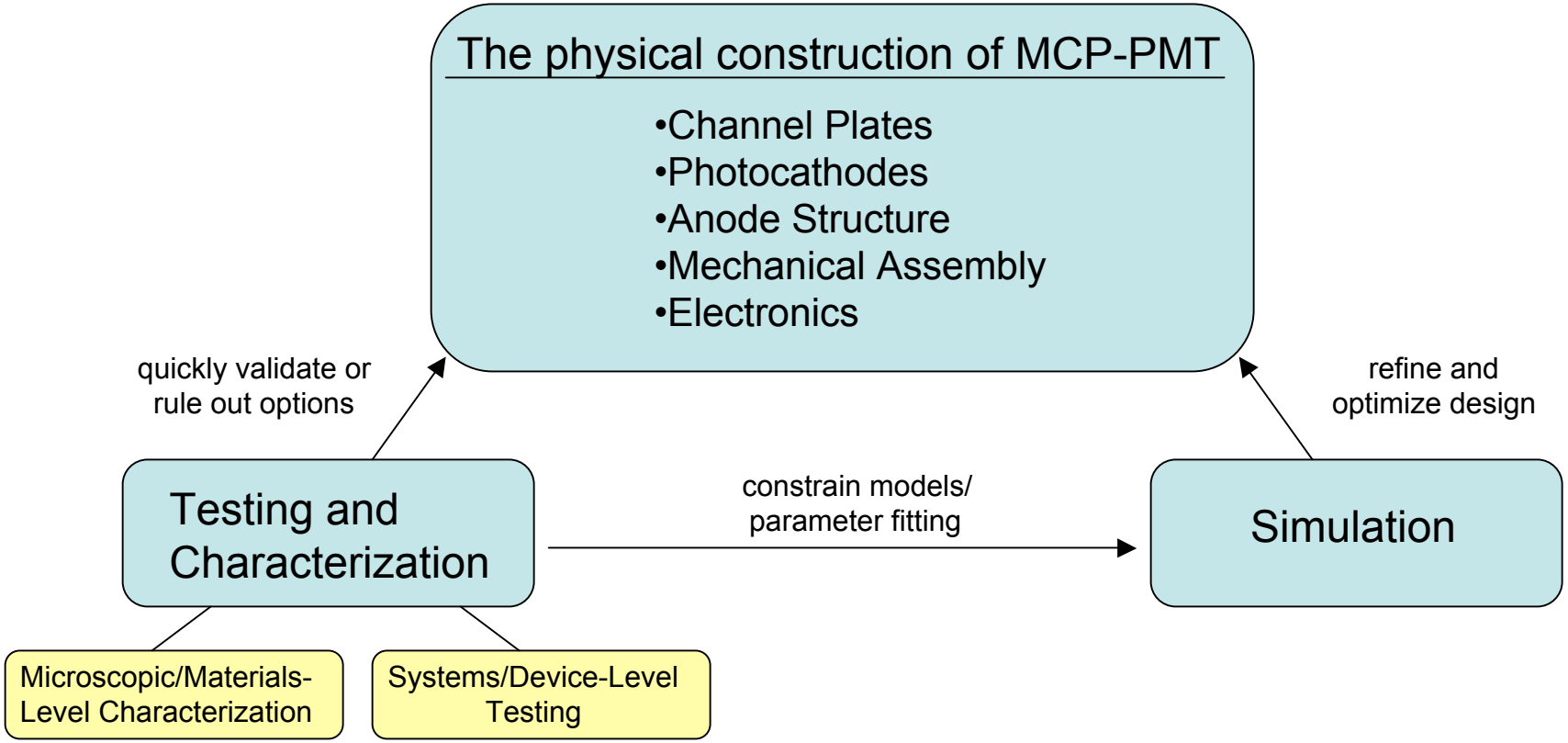
Photocathode Testing and Systems Integration At the Advanced Photon Source

Photocathode group, LAPPD Collaboration

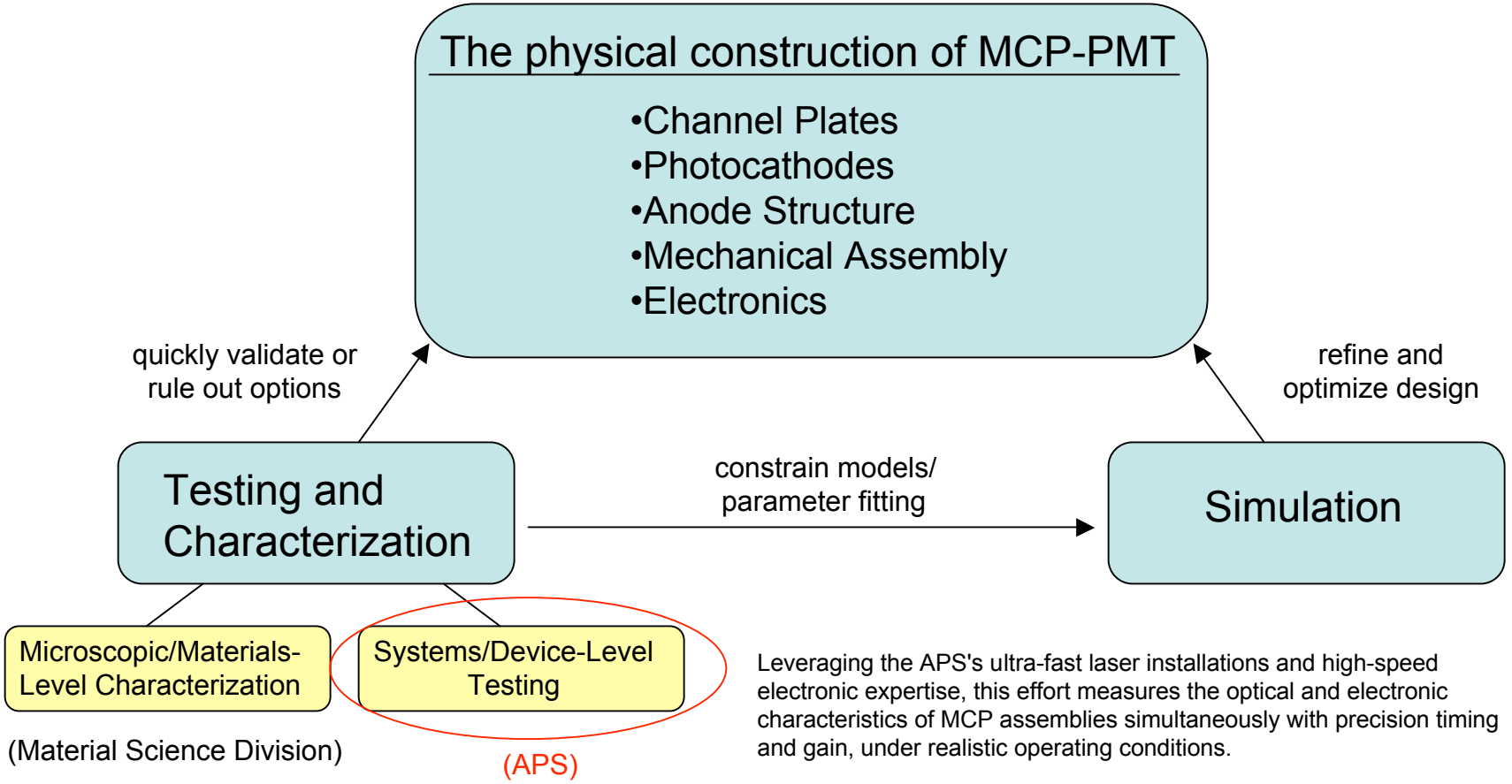
Goals of the APS Test Stand



Goals of the APS Test Stand



Goals of the APS Test Stand



Leveraging the APS's ultra-fast laser installations and high-speed electronic expertise, this effort measures the optical and electronic characteristics of MCP assemblies simultaneously with precision timing and gain, under realistic operating conditions.

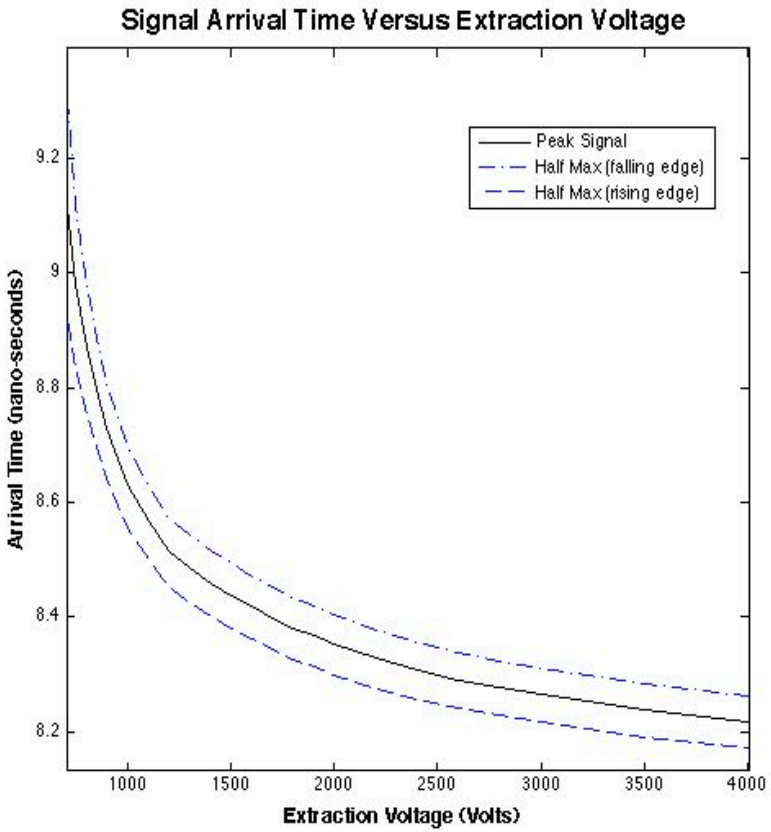
Why Measure Timing?

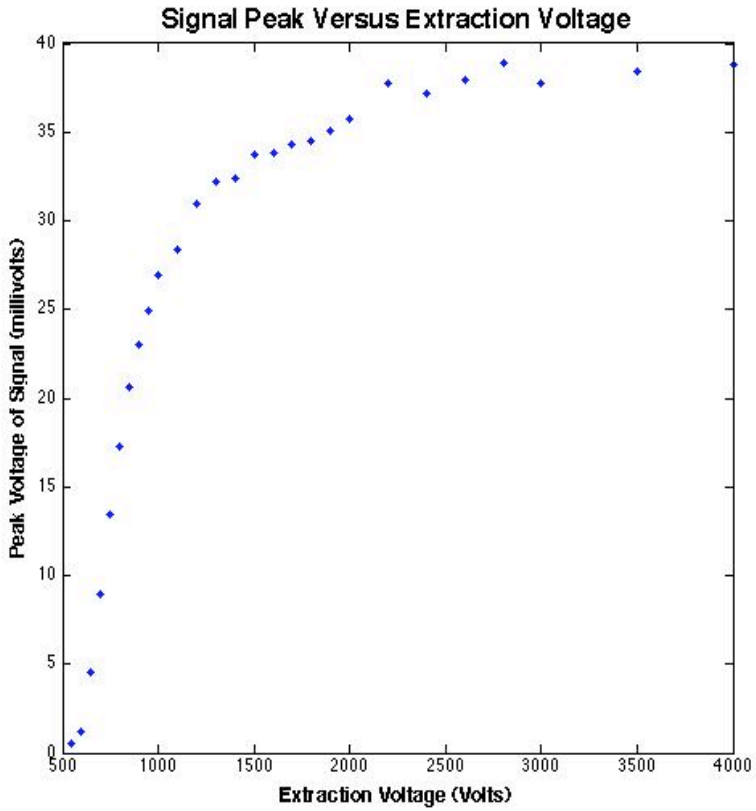
- Special, ultrafast applications for our MCP technology, could become P.C. limited, and benefit from a detailed understanding of timing.
- In any case, precision measurements of timing can provide good data on the underlying physics happening within the P.C.

Better physics through good timing

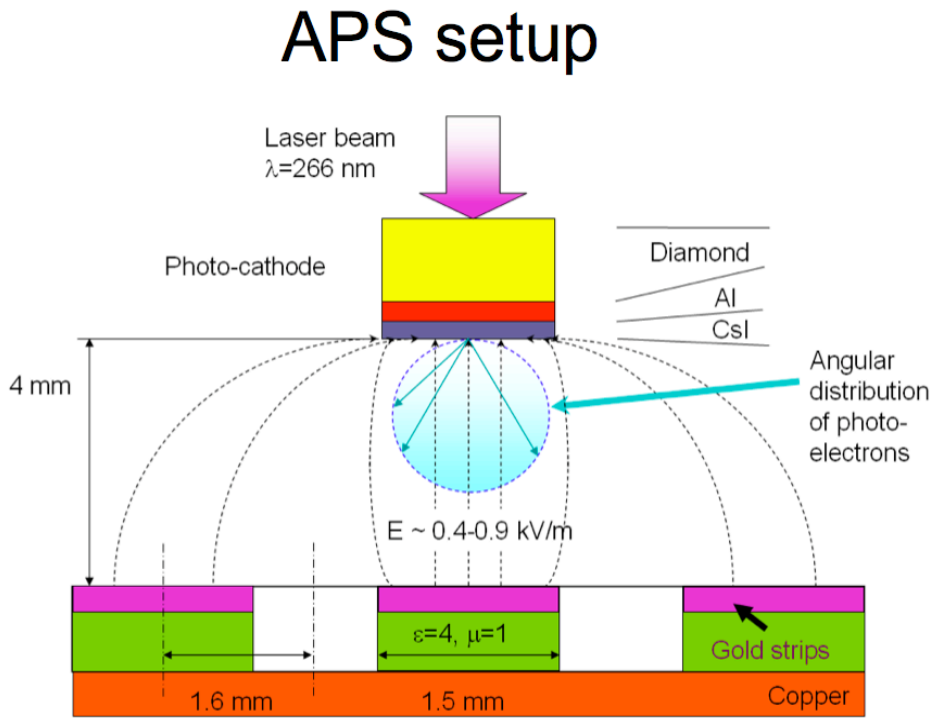
- The LAPPD project explores many P.C. architectures:
  - Different materials
  - Multi-layered structures
  - Various morphologies
  - Different thicknesses
- Precision timing information can be used to understand where photo-electrons are being produced, and how quickly they migrate through particular materials.
- This can help up to understand and diagnose the affects of variations in these P.C. parameters.

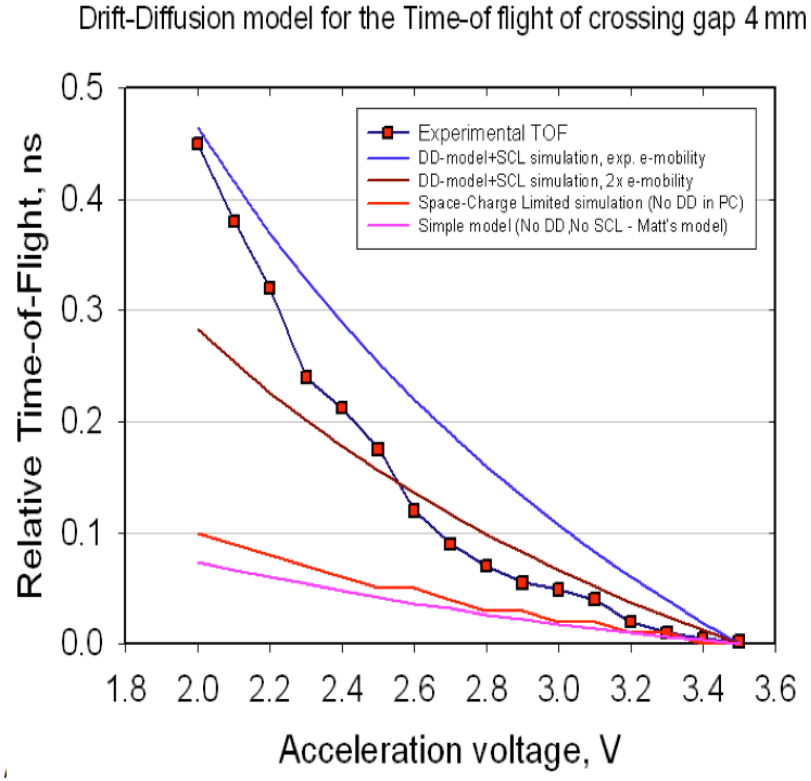
Better physics through good timing





Better physics through good timing

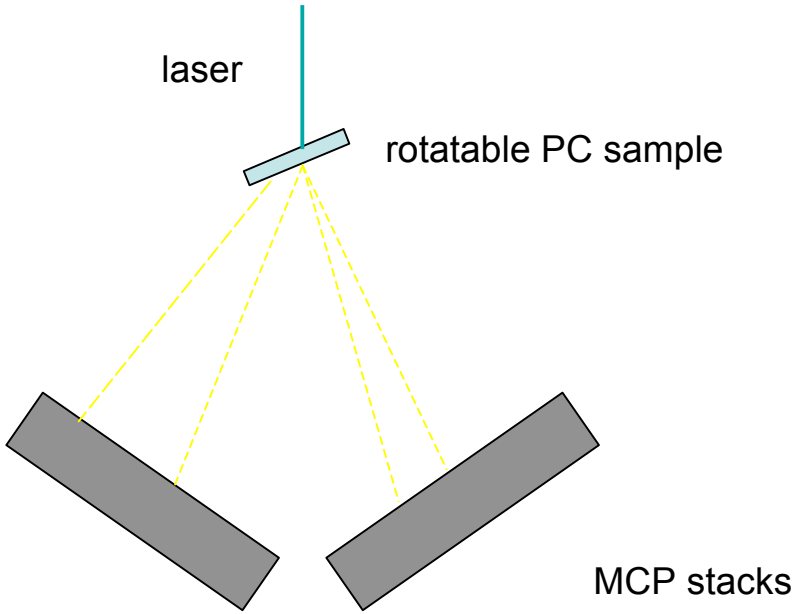




Z. Insepov

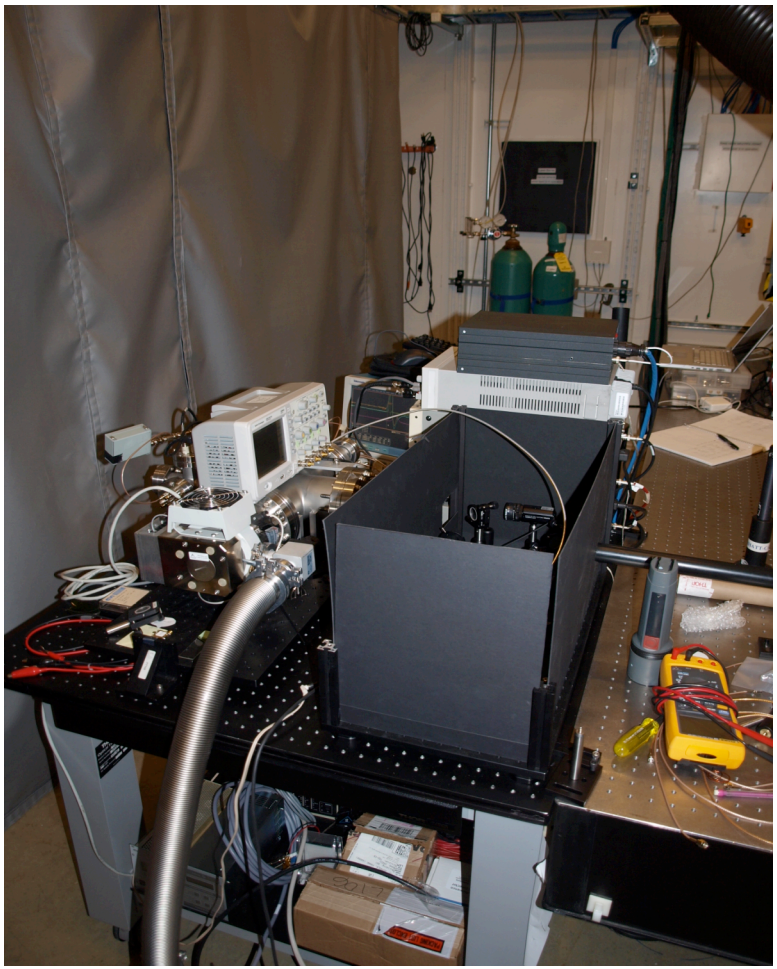
Better physics through good timing

- By measuring time-of-flight at different angles, extraction voltages, and wavelengths with respect to a photocathode sample, we can extrapolate the energy spectrum of out-going electrons.

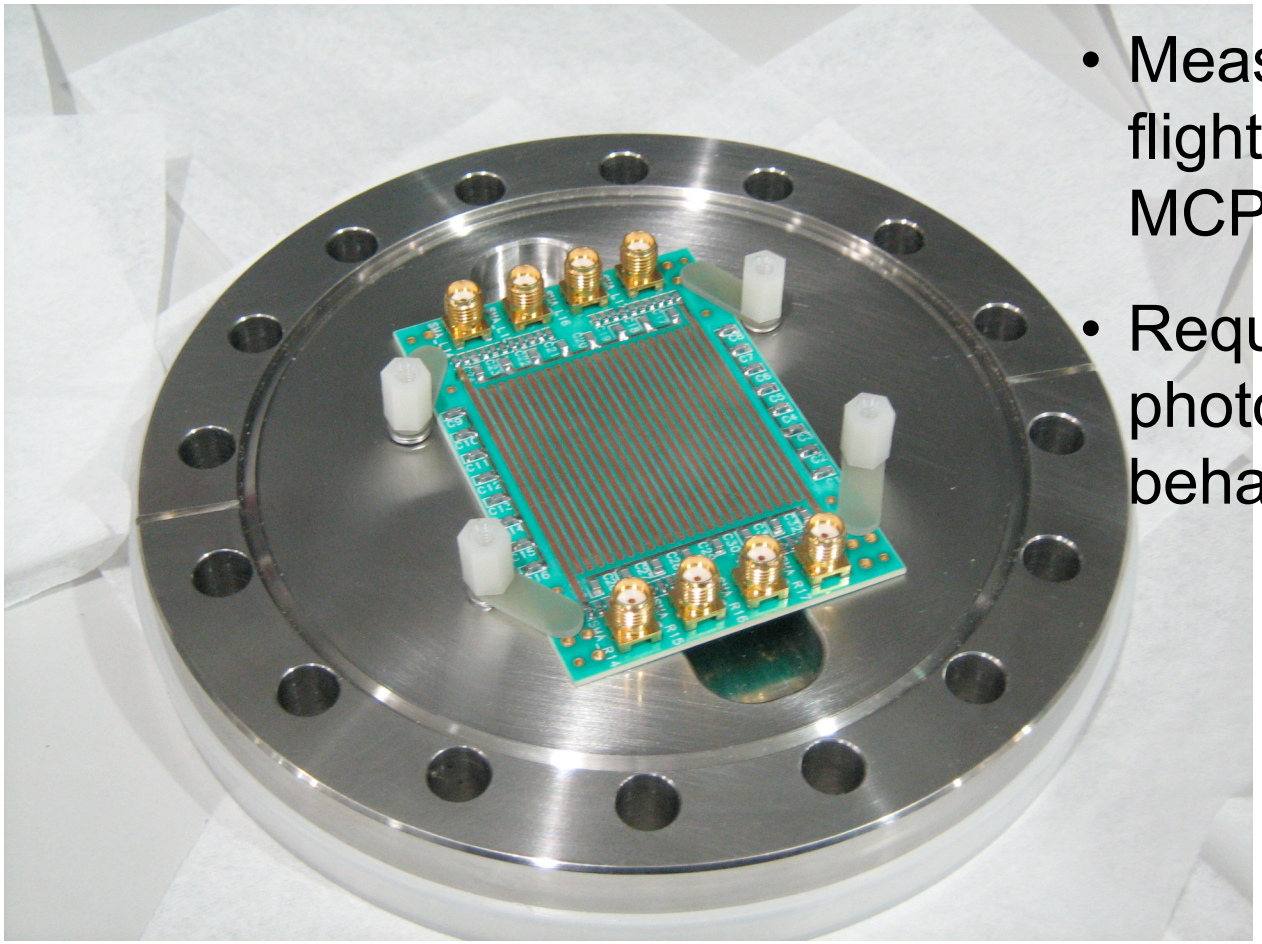


Resources for timing measurements at APS Sector 7

- Ultra-fast streak camera
- MCP/photocathode assembly mounted on compact flange system, ultimately capable of timing resolutions in the <10 ps range
- Timing measurements using 8-GHz and 16 GHz scopes with optimized high bandwidth striplines
- Ti:Sapphire laser (50 fs, 800 nm), frequency-tripled to 266 nm
- A mobile experimental table with modular optics for precise control of beam intensity, composition, position



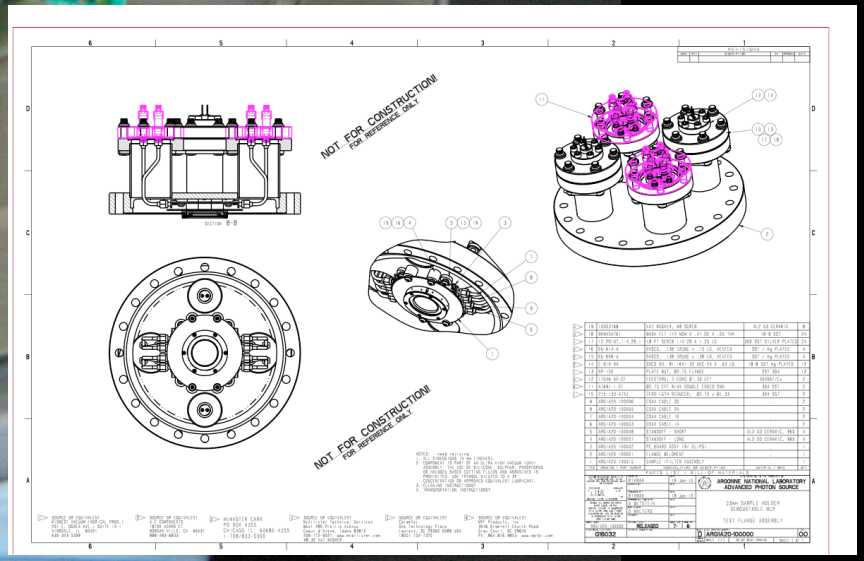
Resources: Bare Anode Assembly



- Measure pure time-of flight. No smearing from MCP.
- Requires lots of photons. May alter P.C. behavior…

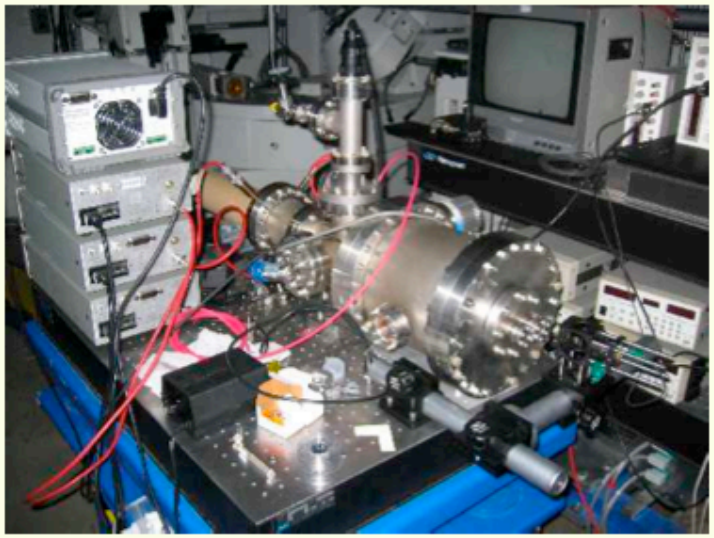
Resources: MCP test assembly

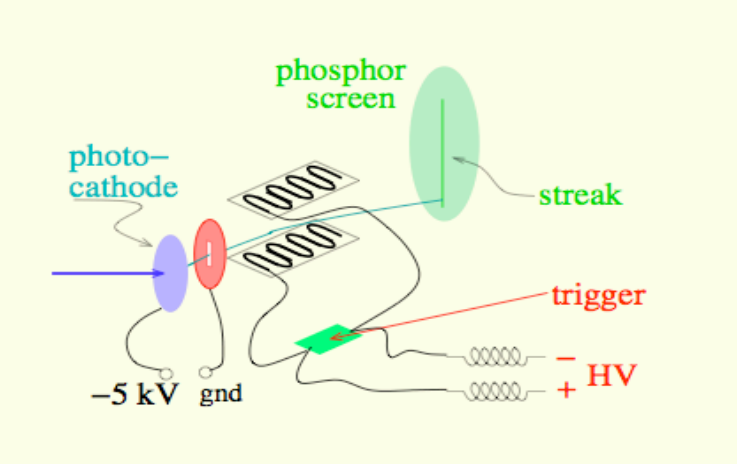
- Can be used with commercial plates as a time of flight detector.
- Is modular, portable, and designed for high bandwidth.

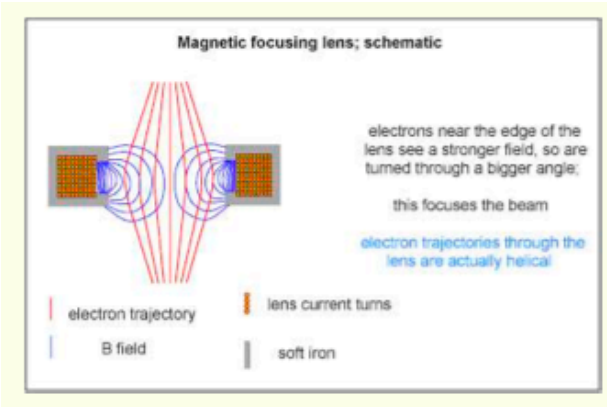


Resources:Streak Camera

- Uses fast, sweeping electric field to spread charge over MCP-phosphor assembly.
- Really precise timing resolution
- Room to make it even more precise
- Portability is a bit of an issue





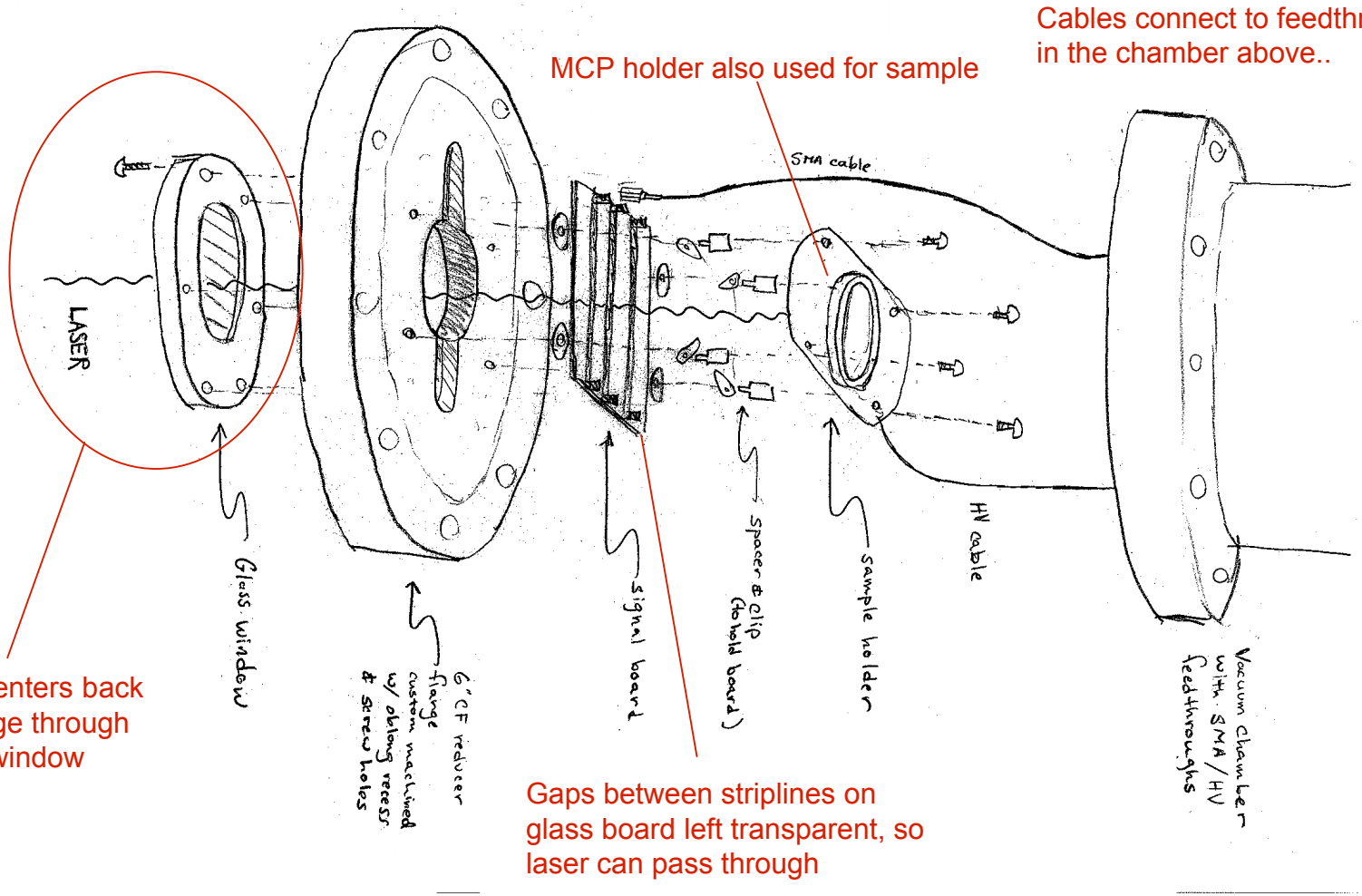


Getting there

- Integrating the APS laser and the sector 7 hardware with the PC fabrication/characterization chamber.
  - Will require logistical planning (where to physically locate resources).
  - Will require engineering work (transfer in vacuum, transfer between different vacuum chambers)
- APS testing
- Man power?

Other possible measurements

Retrofitting an old flange for field enhancement studies



Summary

- We have successfully assembled the right resources, man-power, expertise, and experience necessary to meet our testing goals.
- These resources have, so far, been mainly focused on MCP characterization.
- However, in execution, the differences between channel plate and photocathode characterization is minimal. So, we kill to birds with one stone…
- As the Argonne PC fabrication and testing lab comes together, it will be important to coordinate with the Sector 7 testing.
- There is a lot of interesting physics to learn from this synergy